CRUISE REPORT

MARINE FIELD COURSE 2013
BSc course Geophysics / Oceanography
Module: GBPRA

Cruise No. AL424

September 27 – October 4, 2013
Kiel– Aarhus (Denmark) – Frederikshavn (Denmark) – Kiel

Christian Hübscher and AL424 Scientific and Student Party

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Content

Overview

Cruise AL424 with RV ALKOR has been carried out in the frame of the *Marine Field Course GBPRA* module in the BSc program *Geophysics and Oceanography* at the University of Hamburg, and students at the undergraduate level are required to participate in order to receive their degree. The students are supposed to learn:

1. Autonomous studying of background information about the working area.
2. Survey design with given scientific question and time frame
3. Application and maintenance of severe marine-geophysical instruments:
    a. Marine Seismics: GI-Airgun, watergun, sparker, boomer, streamer, recording system
    b. Hydroacoustics: SES 2000 parametric sediment echosounder
    c. Magnetics: SeaSPY magnetometer and gradiometer
    d. Gravimeter
4. Onboard data processing of seismic, magnetometer and echosounder data
5. Data interpretation and synthesis
6. Report writing

Traditionally, this Marine Field Course module has the clear aim to create a “real” research environment for the students. The students are supposed to develop own research targets and to adjust the working schedule to fulfill these aims. Thus, the working schedule is designed to create a data set which can be used not only for the onboard training, but also for student theses.

The cruise started in Kiel on September 23rd and ended October 4th 2013. During harbor calls in Aarhus on September 27th and in Frederikshaven on Septmber 30th were necessary for exchanging student participants and Danish guest scientists.

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FS ALKOR

The research vessel FS 'Alkor' belongs to Leibniz Institute of Marine Sciences GEOMAR, which is based in Kiel, Germany. The vessel was chartered by the University of Hamburg for the purpose of this cruise. The construction of FS 'Alkor' was completed in 1990. The vessel has an overall length of 55.20 meters, a beam width of 12.50 meters and a draught of 4.16 meters. The top cruising speed of the vessel is 12.5 knots and it has a range of up to 7,500 sm(statute miles). FS ALKOR can carry up to 10 crew members and at most 12 scientists during a single cruise. The BRT – gross (bruto) registered tonage – of the vessel is 999.08, or the equivalent of 2,827.40 m^3.

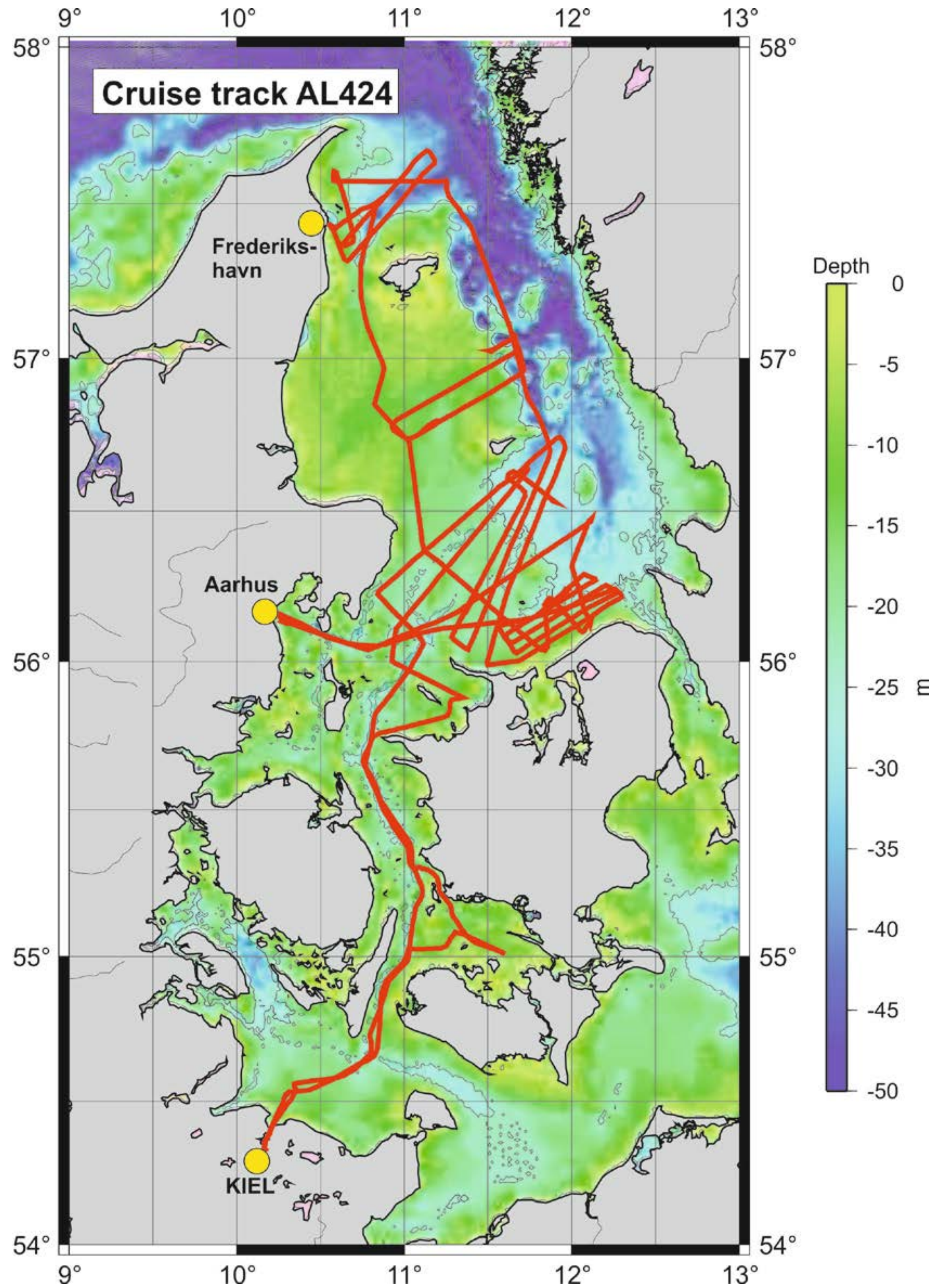

Figure 1: Cruise track AL424.
Leg 1: Kiel 23/09/2013 – Aarhus 27/09/2013
Leg 2: Aarhus 27/09/2013 – Frederikshavn 30/09/2013
Leg 3: Frederikshavn 30/09/2013 – Kiel 04/10/2013

Participants

Name	*Function*	*Institution*	*Legs*
Prof. Dr. Hübscher, Christian	Chief Scientist	IfG-Univ. Hamburg	Leg 1-3
Prof. Dr. Boldrel, Lars Ole (DK)	Guest Scientist DK	Univ. Kopenhagen / GEUS	Leg 3
Bendixen, Carina (DK)	Guest Scientist DK	Univ. Kopenhagen / GEUS	Leg 1-2
Winter, Sven	Technician	IfG-Univ. HH	Leg 1-3
Reiche, Sönke	Senior Scientist	IfG-Univ. HH	Leg 3
Weiß, Benedikt	Senior Scientist	IfG-Univ. HH	Leg 1-2
Ahlrichs, Niklas	Student	IfG-Univ. HH	Leg 1-2
Albert, Mara Wilhelmine Anna	Student	IfG-Univ. HH	Leg 3
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Berdelsmann, Jana	Student	IfG-Univ. HH	Leg 3
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Wirth, Tarek	Student	IfG-Univ. HH	Leg 1-2

Leg 1: Kiel 23/09/2013 – Aarhus 27/09/2013
Leg 2: Aarhus 27/09/2013 – Frederikshaven 30/09/2013
Leg 3: Frederikshaven 30/09/2013 – Kiel 04/10/2013

IfG-Univ. HH: Institut for Geophysics, University of Hamburg

Scientific Aims

The scientific aims of the cruise were multi-folded. One aim is to gain detailed spatial knowledge of the deeper Danish Quaternary basins through the last interglacial glacial cycle (late Saalian to present), the development of Kattegat the last 130.000 years. This will be done by applying seismic information which will result in detailed time and spatial control of the local basin sedimentation systems and will reveal the link to the North Atlantic region during the last interglacial – glacial cycle. It is the aim that the local interglacial and glacial depositional framework will enlightened the Quaternary drainage systems change in time and space through the Kattegat region e.g. the Baltic Ice Lake drainage locations as catastrophic or gradual? The acquired data will help in the identification of the pre-quaternary surface and thereby the construction of a pre-quaternary map showing in greater details the specific level in the Kattegat region. The data elucidate also the link between the presence of fault systems and glacial erosion.

The seismic profile grid has been further designed to map the late Cretaceous contourite firstly described by Surlyk and Lykke-Anderssen (2007). During the Late Cretaceous, high global sea-level meant that most of the NW European craton was flooded by the deep epeiric ‘chalk sea’. The classical paradigm for chalk deposition envisages a quiet rain of pelagic organisms deposited as horizontal, flat-lying pelagic oozes. Seismic data from the Danish Basin and elsewhere necessitate a revision of this paradigm. These demonstrate that the chalk sea floor had a considerable relief, commonly of more than a hundred metres amplitude, comprising moats, drifts, mounds and channels. The architecture and morphology of the moat drift and other features of the chalk sea floor are in all aspects similar to contourite systems of modern continental margins. The chalk contourites have been interpreted by Mogensen & Korstgård (2003) as inversion structures. The analysis of the seismic profiles will therefore refine the common understanding of the tectonic evolution of the Kattegat region.

Geological Setting of Kattegat

The Kattegat region is located in the transition between the Baltic Sea and the North Atlantic in a wrench zone between the Fennoscandian shield and the Danish Basin. This has repeatedly been tectonically active (Abrahamsen 1995). The Sorgenfrei-Tornquist Zone (STZ) is located just south of Anholt and is an old crustal weakness zone. Differential subsidence within the STZ started at the transition between the Late Triassic and the Early Jurassic. The differential subsidence was mainly restricted to the area between the two main faults in the Sorgenfrei–Tornquist Zone, the Grenå–Helsingborg Fault and the Børglum Fault (Mogensen & Korstgård 2003). The zone was repeatedly reactivated during the Triassic, Jurassic and Early Cretaceous, but these were minor events compared to the tectonic events during Late Caboniferous – Early Permian and the Late Cretaceous – Early Tertiary (Mogensen & Korstgård 2003). The last major tectonic event started in the early Late Cretaceous and subsequent Neogene uplift and erosion (Mogensen & Korstgård 2003), is of great importance for the Quaternary development. After these events the area was characterized by no-deposition and net erosion and this lasted until the Late Middle Pleistocene when net sedimentation resumed. The extent of the hiatus represented by an unconformity is unknown, but it is assumed to stretch back to the Late Miocene (Lykke-Andersen et al. 1993).

The southern part of Kattegat is affected by the main Weichselian glacial advances from the north and northeast. It is a transitional shallow water area at the entrance to the Baltic Sea (Bennike et al. 2000) and during the Weichselian glaciations and subsequent deglaciation, the basis of the Kattegat was formed (Conradsen 1995). The deglaciation of the southwestern Scandinavia occurred between 18,000 BP and 13,000 BP (Lagerlund & Houmark-Nielsen 1993) and during the early stage of the deglaciation, the Kattegat region was still not isostatically adjusted which resulted in a high sea level. At around 16,000 BP the ice margin had retreated to the Øresund region and the western part of Skåne. At this stage, the ice margin was directly connected to the Kattegat marine basin by a broad meltwater channel and the Kattegat marine basin was affected by regression due to glacio-isostatic rebound of the crust (Jørn Bo Jensen et al. 2002; J.B. Jensen et al. 2002; Lagerlund & Houmark-Nielsen 1993; Mörner 1969; Thiede 1987) and parts of the

Kattegat region have been under marine influence about 14,000 BP to 13500 BP (Lykke-Andersen et al. 1993).
Within Northern Europe, the late-glacial epoch can be divided into five periods named the Oldest Dryas, Bølling, the Older Dryas, Allerød and the Younger Dryas. The Middle Weichselian/Late Weichselian substage boundary has been dated to be about 25,000 ^{14}C years BP (Mangerud & Berglund 1978) and the Late Weichselian chronostratigraphical terminology is that of *Mangerud et al 1974 and Mangerud & Berglund 1978 (*Fig. *2):* Bøllingen 12,000 - 13,000; Older Dryas 11,800 - 12,000; Allerød 11,000 - 11,800; Younger Dryas 10,000 – 11,000. The Dryas periods were characterized by cold and arctic conditions (Bergsten & Nordberg 1992; Jiang & Klingberg 1996), whereas Bølling and Allerød represent short term warm periods. The older classification methods of the above mentioned periods are based upon known changes in vegetation that can be documented by pollen analysis. Newer research, however, shows a different division (Greenland Stadial and Greenland Interstadial) which is based on climate changes seen in a GRIP ice cores from Greenland (Fig. 3). According to the ice-core records, the classification is as follows: Bølling represents the period 14050 AD to 14700 AD (AD 1950), Older Dryas 13900 AD to 14050, Allerød 12900 AD to 13900 AD, and Younger Dryas 11700 AD to 12900 AD (Björck et al. 1998). However, the Holocene epoch has not been stratigraphic subdivided. The alternation between cold- and warm periods may probably be due to changes in the ocean circulation pattern in the North Atlantic. Major parts of the American and Scandinavian ice shield melted during Bølling which resulted in large amounts of fresh water flowing into the North Atlantic. The fresh water lay on top of the more dense salt water. This diluted the saltwater to the degree that it could not sink and caused an almost discontinued flow of the Gulf Stream or a deflection of the current as far south as Iceland. Because there was no warm current flowing further north, the temperature dropped and sea ice conditions stretched itself further south. This ended the warm period and the climate in Scandinavia was again under arctic conditions (the Older Dryas) (Noe-Nygård et al. 2006). The deglaciation of the Kattegat region began at about 14,000 BP and at this time, the marine basin was relatively open towards the west and northwest (Jiang & Klingberg 1996; Lagerlund & Houmark-Nielsen 1993).
The glaciers grew during the Older Dryas as a result of the colder climate and more freshwater was bound in the ice (Noe-Nygård et al. 2006). This resulted in a current that again could flow north and sink to become a cold and salt rich bottom current. At approximately 12,000 BP, a fjord-like estuary developed in the Kattegat, but large areas in the western Kattegat remained above sea level until the middle Holocene (Jiang & Klingberg 1996; Klingberg 1996; Mörner 1969). The early Kattegat had an opening to the north with contact to the Atlantic waters through the Skagerrak and the North Sea (Klingberg 1996). Two phases of damming of the Baltic Ice Lake occurred followed by a major discharge event. The most extensive one was at its maximum about 12,000 BP. The Baltic Ice Lake was a fresh water lake that formed in the Baltic Sea basin as glaciation retreated from the region. Minor channels through the Great Belt and Øresund drained the Lake and a small land passage separated the Baltic Ice Lake from the sea in the central part of Sweden. A catastrophic discharge event in the central part of Sweden resulted in a drop in the Baltic Ice Lake level of approximately 25 m (Bergsten & Nordberg 1992; Thiede 1987). The Gulf Stream brought warmer water to the North and the Allerød period started. Around 11,500 BP, the Baltic Sea was transformed into a marine basin named the Yoldia Sea. The distribution of sediments derived from Late Weichselian and Holocene in the Kattegat Region is very uneven where they are present in some areas and not in others (Mörner 1969; Gyldenholm et al. 1993; Bergsten & Nordberg 1992).

The same pattern developed for the transition from Allerød to the cold period Younger Dryas as for the transition from Bølling to Older Dryas. During this transition, the temperature dropped more than 6-8°C in the Southern Norwegian Sea and in part because of that, the polar front moved further south. The lowest postglacial sea level in Kattegat reached about 30-40 m below present sea level (b.s.l.) during the Younger Dryas (Bennike et al. 2000) which was due to the fact that the postglacial eustatic sea level rise surpassed the rate of the glacio-isostatic rebound and it caused a lowstand. The uplift of the region continued and the passage through Central Sweden closed and the last lake phase in the Baltic was initiated, Ancylus Lake (Jørn Bo Jensen et al. 2002; Mörner 1969; Richardt 1996). At about 10,200 BP, the Ancylus Lake reached its maximum level and had only narrow drainage pathways through the Great Belt and into the southern part of the Kattegat basin (Fig. 4). The Ancylus Lake was a fresh water lake which water level rose above sea level until it was drained through Öresund strait. Major temperature change was observed at the transition from arctic/subarctic to boreal condition and occured at around 10,200 BP in the Skagerrak-Kattegat basin, whereas it was observed in the eastern North Sea at around 9,600 BP (Knudsen et al. 1996). The southern Kattegat had formed into a large lagoon – estuary basin which was partially blocked by transgressive coastal barriers (Bennike et al. 2000; Jensen et al. 2002)The lowstand level caused erosion of the area and in the early Holocene it was followed by a major transgression (Mörner 1969). At about 10,000 BP, the Ancylus Lake level dropped significantly with about 9 m within a few hundred years; investigations show that the pathway through the Great Belt could only yield the lake level a few metres.

During the Holocene, the Gulf Stream could flow into the North Atlantic without problem (Noe-Nygård et al. 2006). The Great Belt became fully marine at around 9,400 BP which marked the beginning of the Littorina transgression (Jensen et al. 2002). The eustatic rise of sea level became dominant over isostatic uplift throughout the Kattegat area (Fält 1982).

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Stage	Substage	Chronozone	Definitions of Boundaries in Conventional ^{14}C Years B.P.
Holocene	Late Holocene	Subatlantic (SA)	
			2,500
	Middle Holocene	Subboreal (SB)	
			5,000
		Atlantic (AT)	
			8,000
	Early Holocene	Boreal (BO)	
			9,000
		Preboreal (PB)	
			10,000
Weichsel	Late Weichselian	Younger Dryas (YD)	
			11,000
		Alleröd	
			11,800
		Older Dryas	
			12,000
		Bölling	
			13,000
			25,000

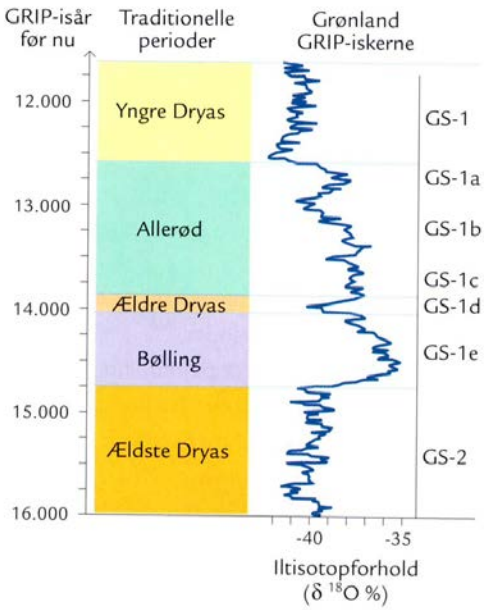

Figure 2: Definitions of Chronozones according to Mangerud et al., 1974 and Mangerud & Berglund, 1978. The ages are interpreted as ^{14}C-ages (Nordberg 1991).

Figure 3: A more accurate deviation of the periods using $\delta^{18}O\%$ derived from GRIP ice core. The link between the old and new classification (Noe-Nygård et al. 2006).

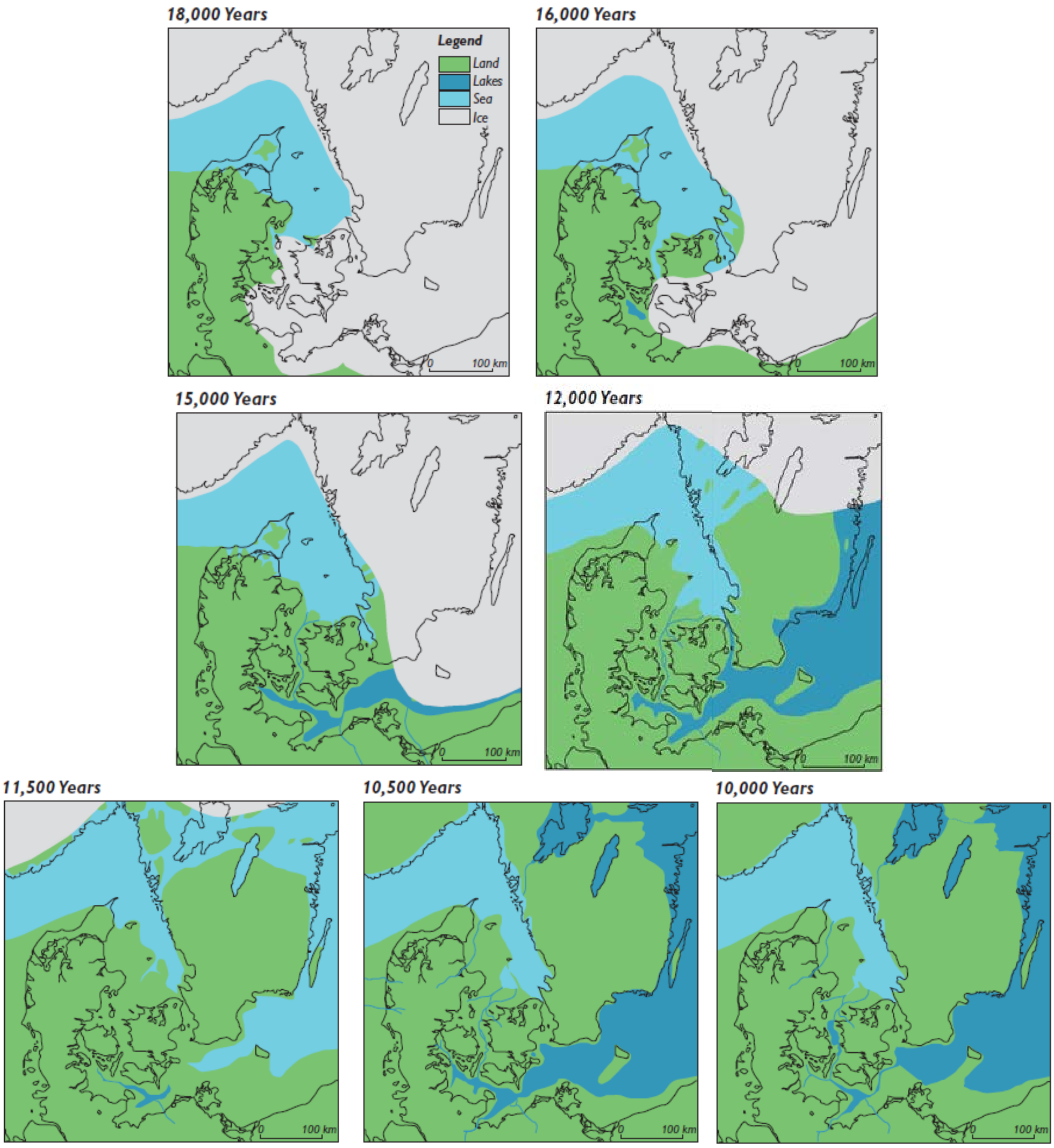

Figure 4: Palaeographical maps showing different evolutions throughout the last 18,000 years. At 18,000 years before present has the glaciers retreated from the Kattegat. At 16,000 years BP a broad meltwater channel existed in the Great Belt. The glacier margin is located west of Bornholm at about 15,000 BP. The Baltic Ice Lake existed in the south-western part of the Baltic Sea at 12,000 BP. At around 11,500 years BP, large landmasses covers the Danish area and the Yoldia Sea entered the Baltic basin. The Maximum extension of the Ancylus Lake is found at 10,500 years before present. At 10,500 years BP had the Ancylus Lake water level in the central part of the Baltic dropped with approximately 9 m (Jensen et al. 2002).

Marine Geophysical Instruments

Reflection Seismics

Seismic signals were generated by means of two clustered GI-Guns towed in a depth of appr. 2.5 m. The volume of each GI-Gun was 45 cin for the generator with a 105 cin injector volume. The operation mode was “true GI mode”. The GI-Guns were synchronized by the SureShot trigger system, which displays the source signal of each airgun. During student exercises we further applied an AppliedAcoustic DELTA Sparker with 1800 Joule energy and a Boomer with 350 J.

The data from the analog streamer (16 channels, 100 m active length) were recorded by the R48 StrataView seismograph, which includes a PC based A/D converter with pre-amplification and anti-alias filtering options. The dynamic range depends on sample rate, but it is always higher than 110 db. The CNT-1 controller PC performs storing, quality control (QC), and online plotting on the connected laser printer. Demultiplexed data were stored on RAID hard-drivesQuality control capabilities include several data display windows, which are shot window, gather plot, trigger window, noise window, and tape window. We generally chose a sample rate of 1 ms and a recording length of 2 s. For the impedance matching between the analog streamer and the seismograph we used a charge amplifier.

In order to adapt the daily working plan to our findings, we created time-migrated brutestacks during the survey. Each brute-stack was finalized approximately 1 hour after finishing acquisition of the specific profile. Processing has been carried out by using Seismic Unix. After converting the data from SEG-Y to SU format data where filtered using 10 Hz, 20 Hz, 200 Hz and 400 Hz as filter frequencies. In order to perform geo-referenced binning of the data, a navigation-file including the ship's position (latitude and longitude) for every 10 seconds was generated. The shot times were extracted from the trace headers and the shot positions were calculated by linear interpolation of the navigation data as well as taking the distance between GPS-antenna and gun-array into account. Assuming the streamer to be linear, the channel positions were calculated by knowledge of the channel-spacing and the initial offset, which has been estimated using the direct arrivals at the near offset channel. Subsequently, bins were calculated with a distance of 12.5 m and a binning radius of 25 m. For each line a brute-stack using a nmo-velocity of 1500 m/s was produced. These brute-stacks were roughly migrated in the T-K domain with a constant interval velocity of 1700 m/s. Spherical divergence, absorption and reflection loss was compensated by gain function. A predictive error deconvolution reduced the energy of the sea-floor multiple. Finally, the sections were reconverted to SEG-Y-format in order to upload the geo-referenced dataset to an interpretation system for further analysis.

Single-beam parametric echo sounder and sub-bottom profiler

Bathymetric data and sub-bottom profiles were collected using the SES-2000 Medium. 8 kHz was the frequency of the parametric signal. The wavelet comprised two wave length. On board, data was converted from the raw format to SEG-Y format for later processing. Separate profile sections were merged during this process.

Magnetics

The magnetometers (gradiometers) used were two SeaSPY which are manufactured in Canada by the company Marine Magnetics. The SeaSPY is an omni-directional magnetometer, capable of producing very good results regardless of the direction of the magnetic field. No alignment is necessary when surveying, regardless of course or location. As a rule of thumb, a magnetometer should be towed at sufficient distance from the ship, in order to avoid magnetic interference from the vessel. Thus one magnetometer was towed at a distance of about 250 meters, while the other was kept at a distance of 350 meters. By using two magnetometers, data can be calibrated according to the magnitude of interference present, and the results obtained will then have minimal errors. The SeaSPY, and the flotation cable used for towing and data streaming, have the following specifications:

Data was acquired on a PC running Microsoft Windos, through the application SeaLINK, which provided an interactive text and real-time data plot interface displaying the data streaming in from the magnetometers. Data was recorded and viewed in nanotesla. It was possible to adjust the vertical and horizontal scales of the data plots, a feature that makes it easier to visualize the magnetic anomalies being measured and recorded. Processing included data editing, distance calculation and substraction of the IGRF11. Data were gridded with GMT *nearneighbor* algorithm with a gid size of 0.5 km (Fig. 13). In order to suppress gridding artefacts a wavelength high-pass filter of 10 km was applied (Fig. 13).

Gravimetrics

During the entire duration of the cruise, gravimetric data was collected using a Bodensee gravimetric system, the Sea Gravity Sensor GSS 31. This system was comprised of a gravity sensor, a control unit (Control Electronics ZEK 31M), a sensor unit (Sensor Electronics GE31M) and a power supply(Power Supply PS31M) . This system provides extremely precise measurements of the gravitational field below the vessel, and is capable of instantaneously compensating for yaw, pitch and roll of the ship. For the ship mounted system, a Microsoft Windows application called KSS31 Data Access v.1.2.18 (see ***Figure 8B***) was used to collect and monitor the gravimetric data, with a sampling interval of 5 seconds. All data was recorded in µgal.

The portable gravimeter was only used twice, once before the commencement of the cruise and once at the end of the cruise. Measurements were made at the pier in Kiel harbor, right in front of the mooring position of FS 'Alkor.' The resulting µgal values were recorded manually.

Working program and First Results

Seismics Profile Network

The location of the seismic profiles is shown in Fig 5. Echosounder data were collected both during all seismic and magnetic lines. See Appendix for profile list.

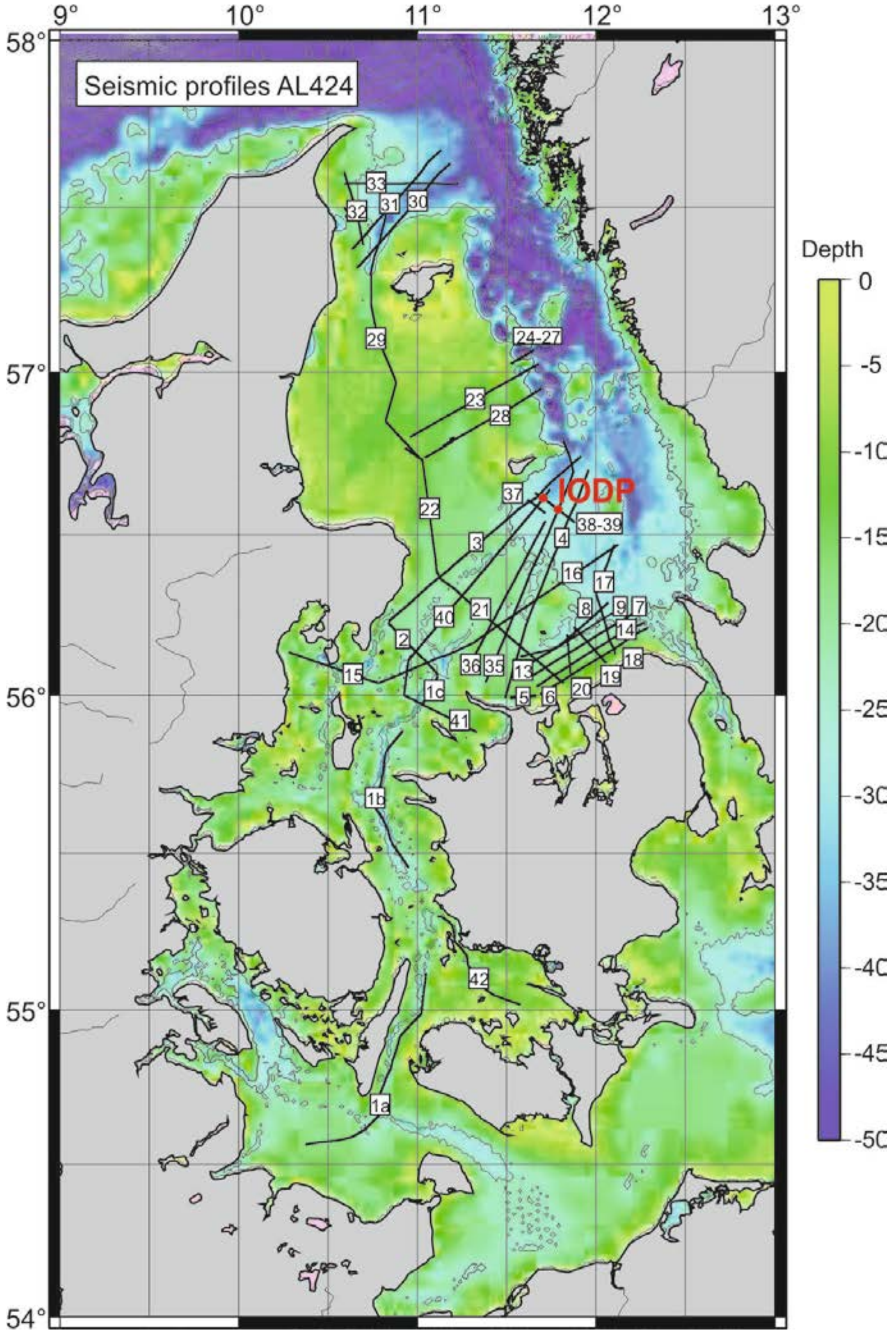

Figure 5: Seismic profiles collected during AL424. Profiles 10-12 are test profiles along a short segment of Profile 8. Profiles 24-27 are all along the same line, but different energy sources (GI-Gun, watergun, sparker, boomer) were used. Profile 39 is along Profile 38, but the boomer was used. This profile crosses proposed IODP core sites (red circles).

Seismic source comparison

In order to compare different seismic sources in terms of resolution and signal depth penetration GI-Gun Profile 24 was reshot with Sparker, Watergun and Boomer. The SES parametric echosounder was active along these profiles as well. GI-Gun data are post-stack time migrated brut-stacks, the other data are single-channel common-offset gathers extracted from shot records. A comparison of the GI-Gun with the Sparker records shows a much better vertical resolution for the Sparker data (Fig. 6). Prograding clinoforms and the erosional Quaternary base are better resolved. Shallow gas causes acoustic blanking in the GI-Gun, but perturbations in the Sparker section. Both sections reveal a peculiar phase reversed reflection at ca. 0.3 s TWT which suggests a stratigraphic trap for gas. This horizon was detected in several areas in the Kattegat.

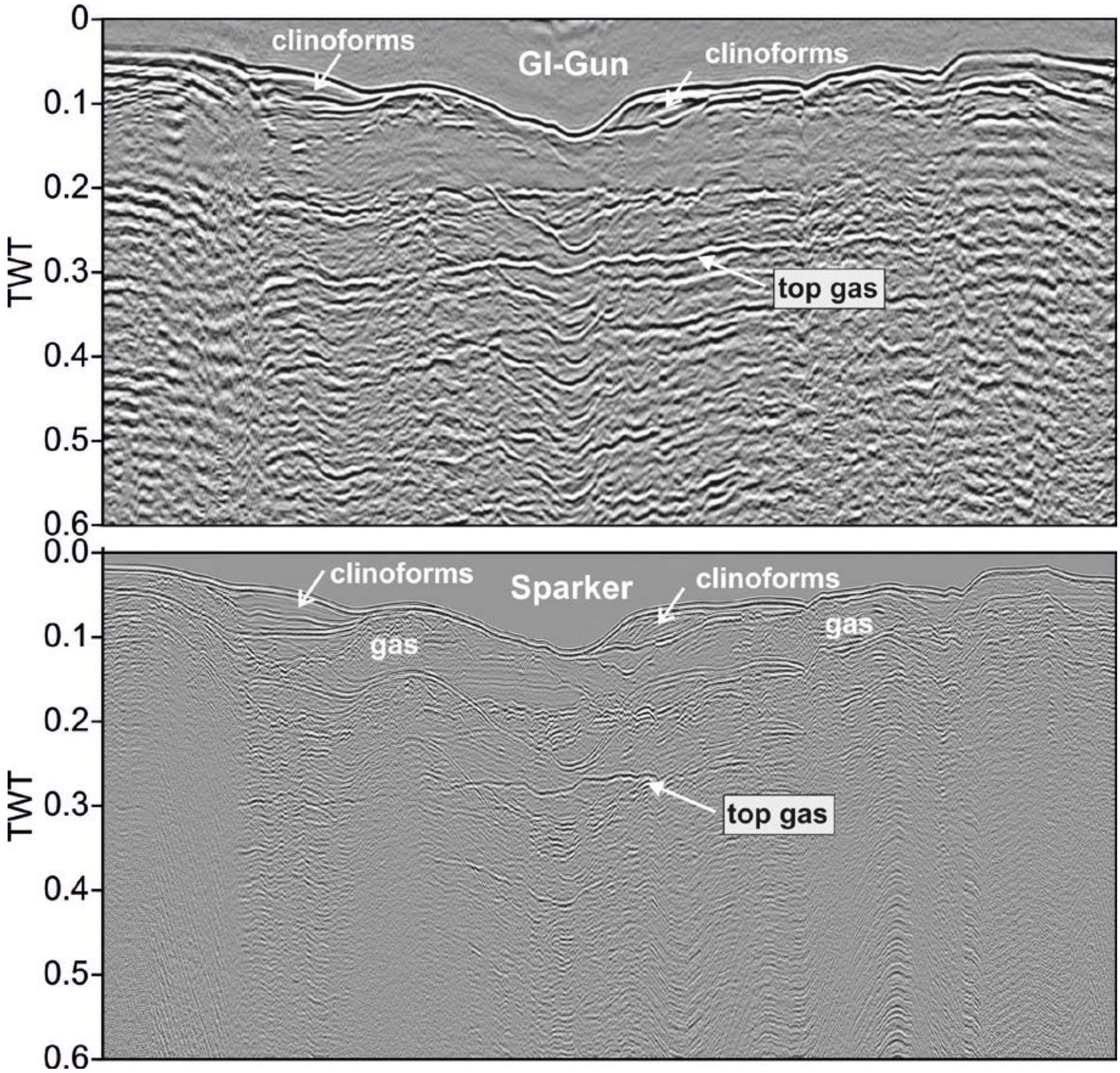

Figure 6: Profile 24 shot with GI-Gun and Sparker as seismic source. See text for discussion

Compared to the Sparker the Watergun data reveal a lower signal to noise ratio (Fig. 7). The precursor signal, which results from the p-wave created by the Watergun's piston acceleration, superimposes with primary information and reduces resolution. The Boomer data suffer from from the signal reduction due to the high gas content of the shallow sediments. The gassy sediments reveal seismic perturbation. The top of the shallow gas represents a strong impedance contrast for the 8 kHz echosounder data. The top of gas appears as a strong reflection which allows no signal transmission.

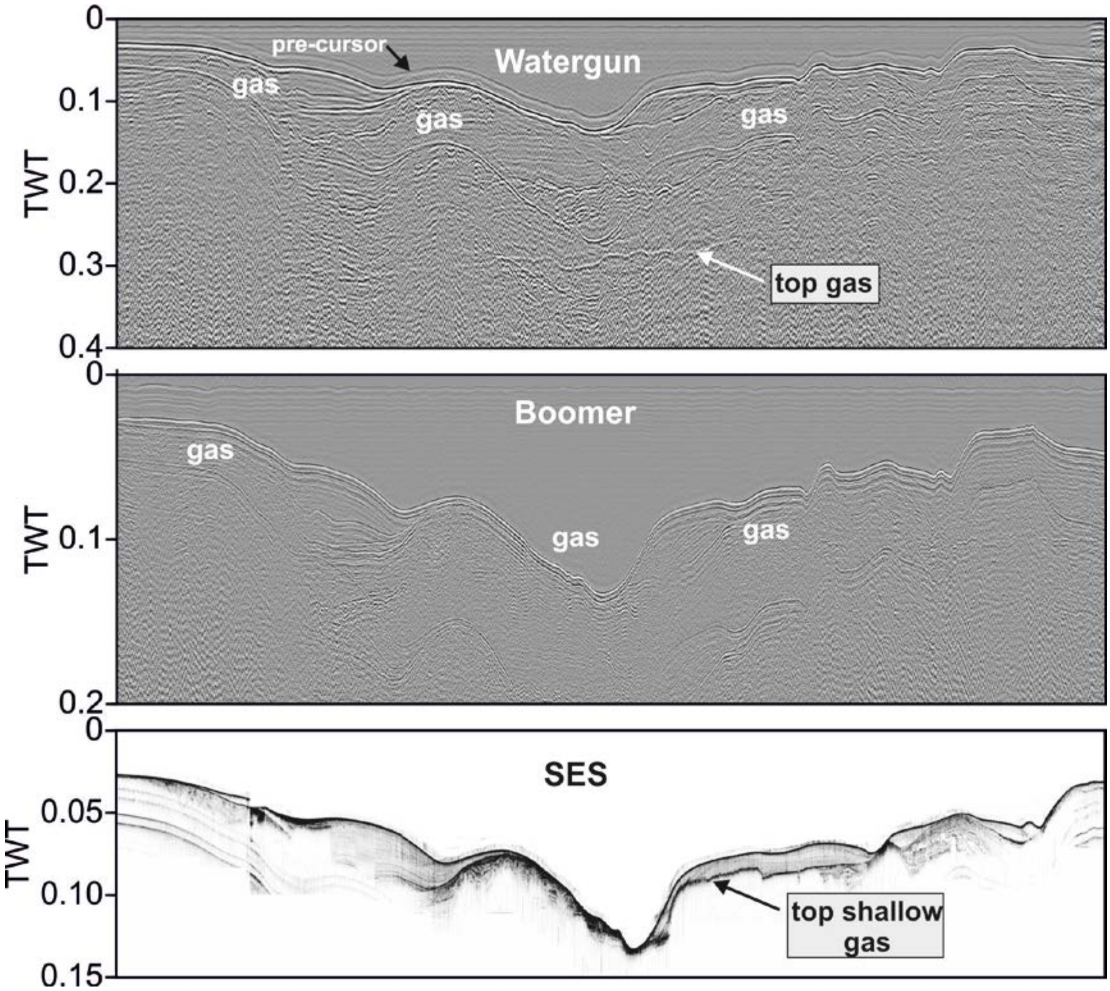

Figure 7: Watergun, Boomer and SES echosounder data along Profile 24. See text for discussion.

Reflection seismic profiling

The first instance is a sub-section of Profile 01a which crosses the so-called Langeland diapir (Fig. 8).

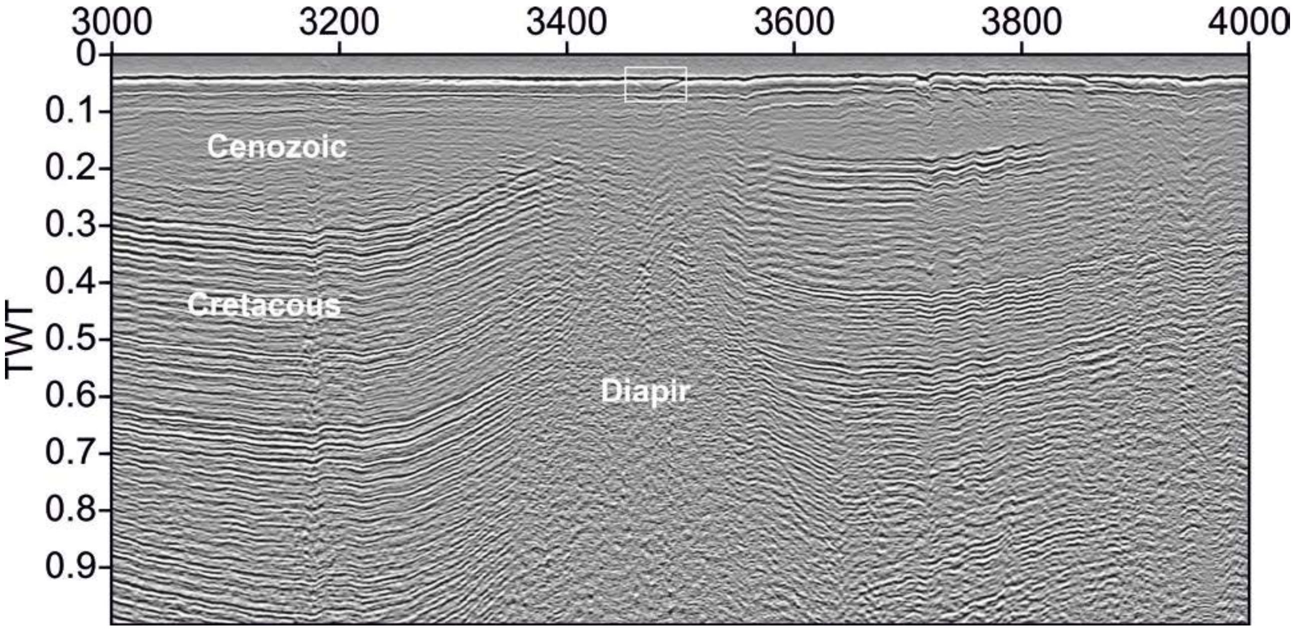

Figure 8: Seismic profile 1a across salt diapir a south-western edge of Langeland. The depression in the uppermost Holocene deposits suggest a crestal graben and – consequently – active tectonics. See Fig. 5 for location.

The next instance is the W-E striking profile 15 off Aarhus (Fig. 9). Cenozoic strata pinch out in the center of the line, where no post-glacial strata are deposited. At the eastern and western end the glacial erosional unconformity is overlain by Quaternary deposits. Faults cutting through the Cretaceous reach into the Cenozoic strata.

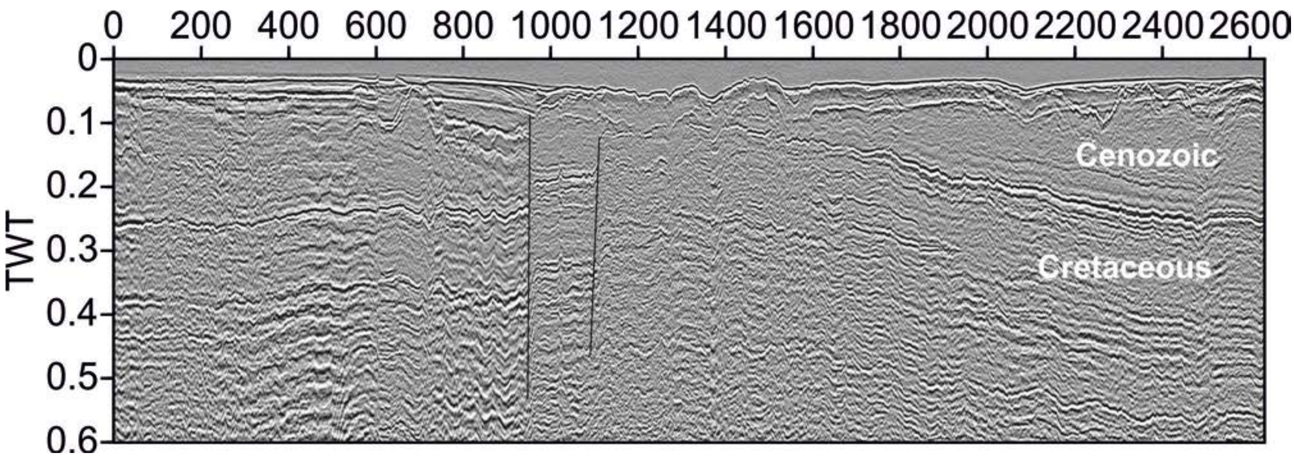

Figure 9: Seismic profile 15 off Aarhus. See text for discussion. For location see Fig. 5.

Profile 16 (Fig. 10) prolongs Profile 15 and crosses the late Cretaceous Chalk contourite as described by Surlyk and Lykke-Anderssen (2007). The upward convex contourite thins towards the TTZ where a moat channel was created by the contour parallel current which was obviously active in those times.

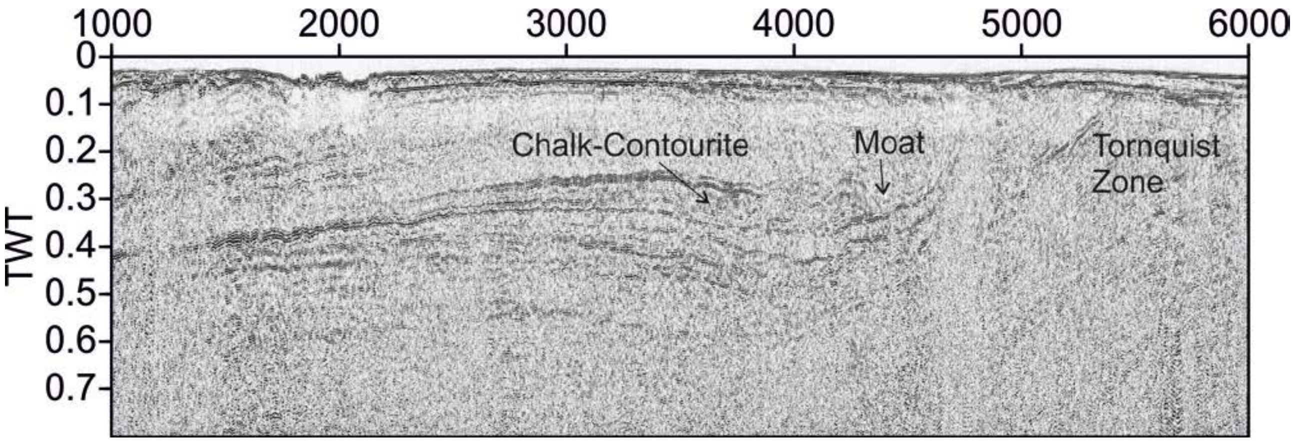

Figure 10: Profile 16. See text for discussion. For location see Fig. 5.

The northern Kattegat reveals a westward increasing thickness of post-glacial deposits overlying two erosional unconformities (Fig. 11).

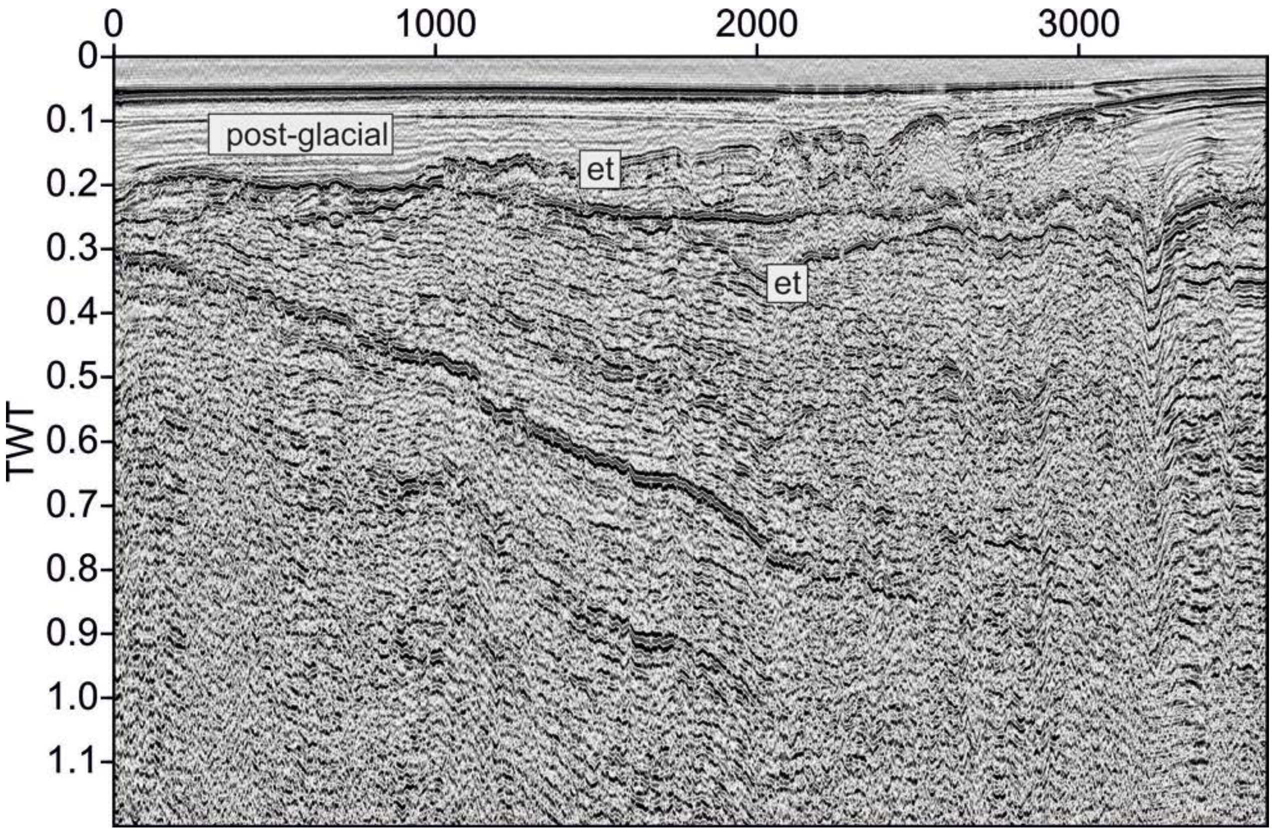

Figure 11: Profile 31 from northern Kattegat. et: erosional truncation. For location see Fig. 5.

The Tornquist Zone is characterized by tilted blocks, a horizontal phase reversed reflections at 0.2 s TWT, and a south-west dipping phase reversed reflection between 0.4 and 0.6 s TWT (Fig. 12). The erosional truncation correlates partly with tilted blocks and normal faults.

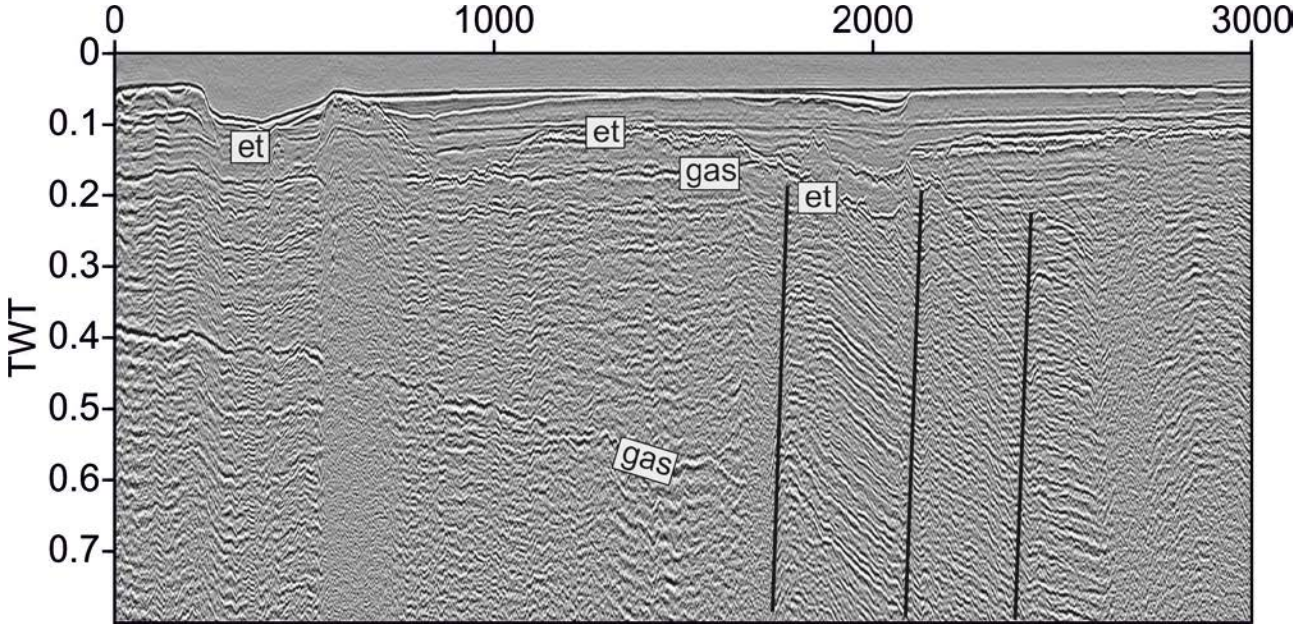

Figure 12: Part of Profile 35 from central Tornquist Zone. See text for discussion and Fig. 5 for location.

Magnetics

Magnetic data were IGRF11-corrected and gridded with nearneighbor algorithm with a cell width of 0.5 km. We further applied a 10 km wavelength high-pass filter (see Fig. 13). South of Anholt, two anomalies suggest the presence of batholiths.

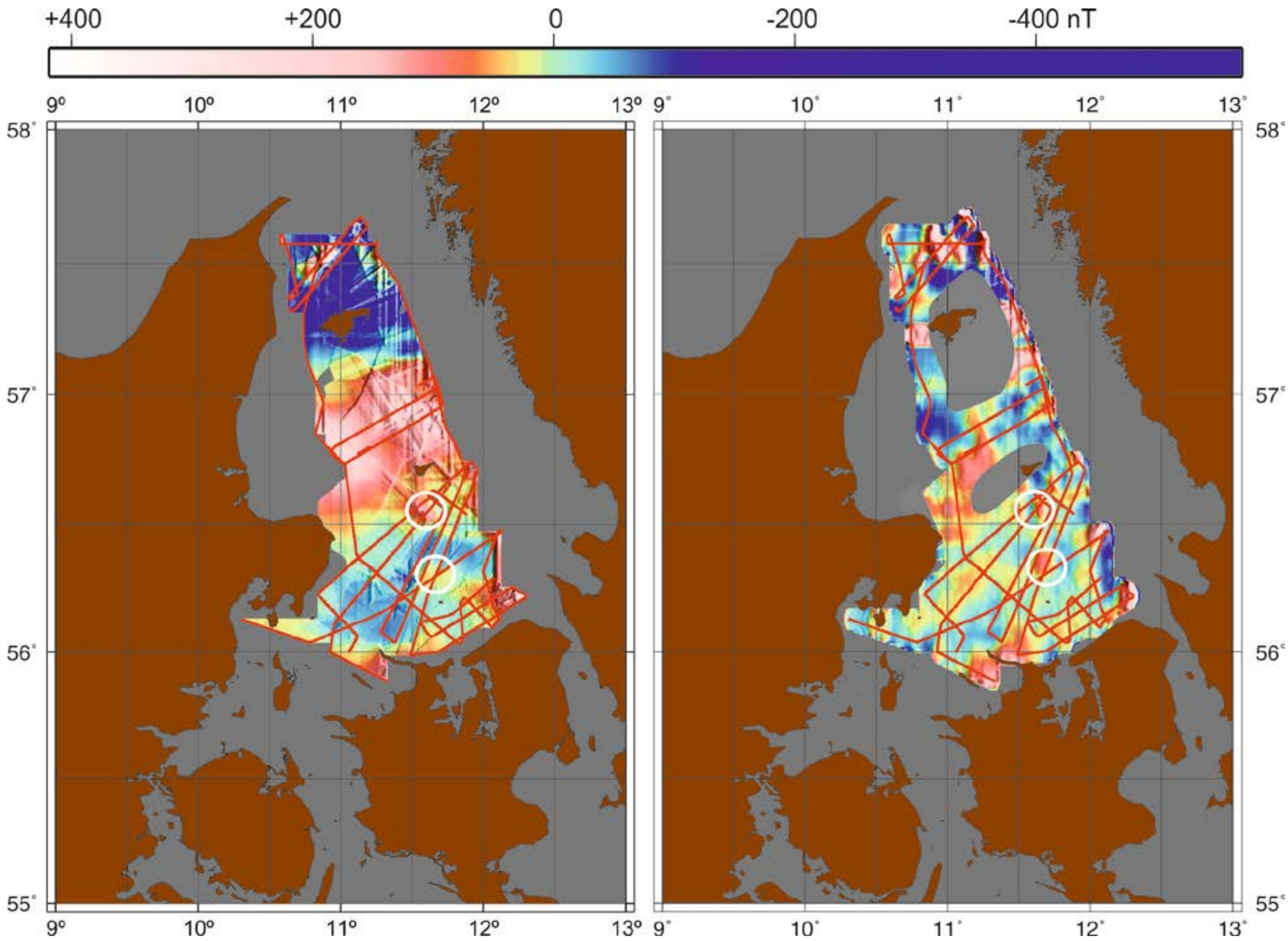

Figure 13: Left: gridded IGRF11 corrected data from single magnetic sensor. Right: Same data after 10 km wave length filter (high-pass). White circles mark possible batholiths.

Acknowledgements

We like to thank captain Secchi, his officers and crew of RV ALKOR for their support of our measurement programme and for creating a very friendly atmosphere on board. We further like to thank Lars Ole Boldrel, the German Federal Foreign Office, the German Embassy Copenhagen and the Danish Ministry of Climate, Energy and Building for their crucial support by solving diplomatic issues.

Appendix: Profile List Seismics

Source	Profile	Start				Ende				Length [km]
		Date	UTC	Latitude	Longitude	Date	UTC	Latitude	Longitude	
GI45/105	1	23.9.2013	19:11	54° 34,35'N	10° 28,02'E	24.09.2013	16:22	56° 03,62'N	11° 6,83'E	85,562
GI45/105	2	24.9.2013	16:22	56° 3,62'N	11° 6,83'E	24.09.2013	19:00	56° 13,36'N	10° 50,47'E	25,425
GI45/105	3	24.9.2013	19:00	56° 13,36'N	10° 50,47'E	25.09.2013	04:25	56°44,46'N	11° 54,95'E	87,712
GI45/105	4	25.9.2013	05:03	56° 42,07'N	11° 57,50'E	25.09.2013	14:02	55° 49,40'N	11° 29,46'E	84,225
Watergun	5	25.9.2013	14:21	55° 59,33'N	11° 30,95'E	25.09.2013	15:49	55° 59,94'N	11° 38,65'E	7,869
GI45/105	6	25.9.2013	16:24	56° 00,19'N	11° 41,45'E	25.09.2013	21:16	56° 12,71'N	12° 17,52'E	44,112
GI45/105	7	25.9.2013	22:08	56° 15,20'N	12° 12,41'E	26.09.2013	02:32	56° 03,66'N	11° 38,57'E	41,037
GI45/105	8	26.9.2013	03:30	56° 07,18'N	11° 34,61'E	26.09.2013	07:28	56° 17,36'N	12° 04,24'E	36,962
Boomer	9	26.9.2013	08:16	56° 16,93'N	12° 08,75'E	26.09.2013	11:09	56° 10,63'N	11° 51,82'E	20,639
Boomer	10	26.9.2013	11:36	56° 11,24'N	11° 51,66'E	26.09.2013	12:42	56° 13,97'N	11° 57,54'E	7,8286
Watergun	11	26.9.2013	13:07	56° 13,87'N	11° 57,29'E	26.09.2013	14:10	56° 11,10'N	11° 51,67'E	7,544
Sparker	12	26.9.2013	14:39	56° 11,32'N	11° 52,11'E	26.09.2013	15:38	56° 14,05'N	11° 57,73'E	6,988
Boomer	13	26.9.2013	16:26	56° 12,12'N	11° 56,15'E	26.09.2013	19:23	56° 05,96'N	11° 37,03'E	21,873
Boomer	14	26.9.2013	20:38	56° 01,63'N	11° 40,12'E	27.09.2013	02:27	56° 13,69'N	12° 16,42'E	41,750
GI45/105	15	27.9.2013	15:04	56° 08,01'N	10° 17,04'E	27.09.2013	18:39	56° 02,28'N	10° 47,16'E	32,912
GI45/105	16	27.9.2013	18:39	56° 02,28'N	10° 47,16'E	28.09.2013	05:03	56° 28,12'N	12° 07,38'E	96,487
GI45/105	17	28.9.2013	05:18	56° 28,08'N	12° 06,21'E	28.09.2013	07:14	56° 19,23'N	12° 00,08'E	17,750
GI45/105	18	28.9.2013	07:14	56° 19,23'N	12° 00,08'E	28.09.2013	09:54	56° 07,50'N	12° 06,30'E	22,600
GI105/105	19	28.9.2013	11:13	56° 06,02'N	12° 03,47'E	28.09.2013	13:05	56° 12,76'N	12° 52,53'E	17,000
GI105/105	20	28.9.2013	13:27	56° 11,51'N	11° 50,34'E	28.09.2013	15:03	56° 03,48'N	11° 51,51'E	14,888
GI105/105	21	28.9.2013	15:28	56° 02,27'N	11° 49,16'E	28.09.2013	21:32	56° 22,25'N	11° 07,18'E	57,300
GI105/105	22	28.9.2013	21:32	56° 22,25'N	11° 07,18'E	29.09.2013	02:41	56° 46,02'N	10° 55,95'E	47,613
GI105/105	23	29.9.2013	03:11	56° 48,05'N	10° 57,73'E	29.09.2013	08:38	57° 01,56'N	11° 40,90'E	50,638
GI105/105	24	29.9.2013	09:13	57° 04,11'N	11° 39,17'E	29.09.2013	10:23	57° 01,50'N	11° 31,31'E	9,300
Boomer	25	29.9.2013	11:02	57° 01,50'N	11° 31,39'E	29.09.2013	12:16	57° 04,07'N	11° 39,30'E	8,904
Watergun	26	29.9.2013	12:46	57° 04,06'N	11° 39,34'E	29.09.2013	14:01	57° 01,48'N	11° 31,28'E	9,032

Sparker	27	29.9.2013	14:21	57° 01,48'N	11° 31,31'E	29.09.2013	15:35	57° 05,06'N	11° 39,27'E	8,852
GI105/105	28a	29.9.2013	17:23	56° 57,00'N	11° 41,75'E	29.09.2013	21:37	56° 46,05'N	11° 07,62'E	53,150
GI105/105	28b	29.9.2013	22:33	56° 47,48'N	11° 07,62'E	30.09.2013	00:07	56° 44,21'N	11° 02,39'E	13,975
GI105/105	29	30.9.2013	00:20	56° 44,35'N	11° 00,47'E	30.09.2013	10:13	57° 30,19'N	10° 50,19'E	92,162
GI105/105	30	30.9.2013	15:13	57° 19,05'N	10° 39,87'E	30.09.2013	20:24	57° 38,01'N	11° 11,10'E	47,275
GI105/105	31	30.9.2013	20:58	57° 40,28'N	11° 08,17'E	01.10.2013	01:20	57° 22,29'N	10° 38,00'E	44,825
GI105/105	32	01.10.2013	01:56	57° 23,23'N	10° 41,85'E	01.10.2013	04:25	57° 36,41'N	10° 35,32'E	25,400
GI105/105	33	01.10.2013	04:57	57° 34,25'N	10° 35,61'E	01.10.2013	08:47	57° 34,31'N	11° 14,05'E	38,462
GI105/105	35	01.10.2013	15:10	56° 47,37'N	11° 49,04'E	01.10.2013	23:58	56° 02,47'N	11° 22,83'E	89,987
GI105/105	36	02.10.2013	00:51	56° 04,98'N	11° 17,00'E	02.10.2013	08:35	56° 32,54'N	11° 43,02'E	61,2375
GI105/105	37	02.10.2013	08:53	56° 34,03'N	11° 42,91'E	02.10.2013	09:40	56° 36,53'N	11° 36,88'E	7,625
GI105/105	38	02.10.2013	10:13	56° 37,52'N	11° 39,53'E	02.10.2013	12:06	56° 32,20'N	11° 53,00'E	17,150
Boomer	39a	02.10.2013	12:34	56° 32,16'N	11° 52,96'E	02.10.2013	12:35	56° 32,16'N	11° 52,96'E	2,072
Boomer	39b	02.10.2013	12:36	56° 32,16'N	11° 52,96'E	02.10.2013	14:39	56° 57,26'N	11° 40,66'E	147,476
GI105/105	40	02.10.2013	15:83	56° 38,30'N	11° 44,43'E	03.10.2013	00:41	55°59,90'N	10°55,62'E	88,825
GI105/105	41	03.10,2013	00:41	55°59,90'N	10°55,62'E	03.10.2013	03:36	55°53,02'N	10°19,95'E	28,488
GI105/105	42	03.10.2013	10:14	55°18,00'N	11°06,88'E	03.10.2013	15:55	55° 01,07'N	11° 34,64'E	46,812